AVIATION

FEBRUARY 19, 1923 Issued Weekly PRICE 10 CENTS

New Navy torpedo plane, now being produced in quantity for the United States fleet squadrons

Official Photo, U. S. Navy

VOLUME XIV

Number 8

SPECIAL FEATURES

THE DESIGN OF METAL AIRPLANES

THE STORY OF TRANSPORTATION BY AIR

REGULATIONS OF SCHNEIDER SEAPLANE RACE

ANNUAL REPORT OF AERO CHAMBER OF COMMERCE

THE GARDNER, MOFFAT CO., INC.
HIGHLAND, N. Y.
225 FOURTH AVENUE, NEW YORK

Entered as Second-Class Matter, Nov. 22, 1920, at the Post Office at Highland, N. Y, under Act of March 3, 1879.

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VOL. XIV NO. 8

Member of the Audit Bureau of Circulations

CONTENTS

THE GARDNER, MOFFAT COMPANY, Inc., *Publishers*

HIGHLAND, N Y

225 FOURTH AVENUE, NEW YORK

Subscription price Four dollars per year Single copies ten cents. Canada, five dollars Foreign, six dollars a year Copyright 1923, by the Gardner, Moffat Company, Inc

Issued every Monday Forms close ten days previously Entered as second-class matter Nov 22, 1920, at the Post Office at Highland, N Y, under act of March 3, 1879

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Vol XIV FEBRUARY 19, 1923 No 8

Progress in Helicopters

SOME encouraging news has recently been made public with respect to experiments with helicopters. While the problem of building a practical helicopter is yet far from its definite solution, it seems that the unflagging energy and ingenuity of the experimenters is beginning to bear more than theoretical results.

The problem of the helicopter is fourfold: first, it must lift off the ground and be capable of hovering; second, it must be stable in flight; third, it must be capable of flight in the horizontal plane; and fourth, it must safely descend in case of engine failure.

The first of these problems, that of lifting off, is the easiest of the four and can be considered as solved. To mention only recent types, the Berliner and the De Bothezat helicopters in this country, the Pescara in France, and the Petroczy-Karman Zurovec in Austria, all have lifted off to a certain height, the last named ascending to about 150 ft when held to the ground by three cables. The reason for the cables falls under the second requirement, stability, which is an extremely difficult problem.

The Austrian helicopter was admittedly unstable in free flight, and it was for this reason that it was tested "captive." In all the more recent helicopters some provision is made for stability, either by changing the pitch of the screws (Pescara and de Bothezat) or by blanketing a portion of the disk area (Berliner), or again by means of a gyroscope (Oehmichen). The trials of all these machines have been too short and too few to permit of drawing a definite conclusion as to their stability.

For horizontal flight, helicopters generally embody a provision for inclining the propeller shaft or for changing the pitch of the screws, unless the machine is fitted with a separate tractor propeller. The new Oehmichen-Peugeot helicopter, which embodies the latter arrangement, is credibly reported to have flown horizontally a distance of about 250 ft. This was probably the first authentic performance of its kind, therefore deserving particular mention.

The fourth requirement, safe descent with the engine shut off, has not so far been demonstrated by any helicopter. This is by far the most difficult problem of all. Theoretically it is to be solved by causing the lifting screws to rotate freely under the impulsion of air pressure, the upward component being considered sufficient to insure descent at a safe rate. Free flight experiments alone can demonstrate the practical value of this theory, though empirically it seems reasonable enough.

Those who can see no practical benefit accruing from experiments with helicopters are numerous today; yet fifteen years ago balloonists used the same arguments against airplane experiments and it should not be surprising if fifteen years hence helicopter enthusiasts were to argue in the same manner against ornithopter experiments, should the flapping wing machine stage a "come back." The science of aeronautics is too young and unfinished to warrant the positive statement that the airplane is the only practical solution of mechanical flight.

Metal Airplane Construction

IT is now some three years that the first airplane entirely built of metal, including the covering of wings and fuselage, made its appearance in public. The type in question, the Junkers cantilever thick-wing monoplane, offered some striking evidence of the various advantages of its novel design, but it also embodied some drawbacks which were just as evident.

The chief points in its favor were weather-proofness, a large useful load, and cheap operation and maintenance, all of which may be attributed to the type of metal construction employed, although a thick wing section and an economic engine contributed in a measure to these results. The main drawback was that some portions of the struture of the airplane showed after extensive operation to lack durability owing to the crystallization of duralumin through the effect of vibration. Eventually these defects were obviated by a modification of some of the structural members. Today, after three years' operation in all kinds of climates this type of airplane seems to have retained the advantages originally claimed for it, while most of its drawbacks were overcome.

While the Junkers is of particular interest as a pioneer type in all metal construction, it was soon followed by other types which developed the same idea along different and more advanced lines. In this development there is visible a constant endeavor to simplify the operations which go for turning out the finished product. The multitubular spars, the complicated internal bracing and the corrugated covering of the wings are being displaced by plain box section spars and ribs of sheet metal, bent to suitable shape and riveted, sheet metal longerons and bulkheads, etc. Nor is this development confined to Germany, for the last Paris exposition showed some interesting examples of French metal airplane construction, while in this country a determined effort is also made along this line of thought, the Martin Navy spotting plane being a noteworthy instance of this kind.

The manifold advantages of metal airplane construction are ably set forth in this issue by Messrs. Rey G. Miller and F. E. Seiler, who have been in a condition thoroughly to examine some of the outstanding types of metal airplanes both from the engineering and the operational standpoint. Their contribution will therefore be read with particular interest.

The Design of Metal Airplanes

Outstanding Features of Metal Construction As Illustrated by its Principal Exponents

By Roy G. Miller and I. E. Seiler, Jr.

The main advantages of the metal airplane over its wooden predecessor have become well established facts within the past few years. The problem today is not the choice between wood and metal but rather how best to design and fabricate metal parts. Many airplane designers are unconsciously influenced by the structural shapes employed in wood in the past. Others who have come into aeronautics with experience in structural steel work find it difficult to appreciate a proper balance between cost of production and the refinement of design which low structural weight demands. The development of the steel railway coach offers an excellent example of the struggle between metal and wood. At first it was a question of sacrificing low structural weight to satisfy the public demand for a safe vehicle, but later when the standard structural shapes gave way to special shapes developed for the purpose and when designers became more experienced and specialized the steel railway coach became lighter than the wooden coach.

Advantages of Metal Construction

Metal has the following advantages over wood as a material for airplane construction:

(1) Metal is more reliable and uniform than wood.
(2) Metal may be formed into many structural shapes which would be impossible with wood.
(3) The fabrication of small parts is much quicker and more reliable with metal.
(4) Tension connections may be made with greater ease and with a higher efficiency in metal than in wood.
(5) The yield point is nearer the ultimate strength for metal which permits the design of a structure which will stand a much greater load without permanent set.
(6) Metal is homogeneous and capable of withstanding tension stresses equally well in all directions while the fibrous structure of wood makes it capable of withstanding only about a tenth as much normal to the grain as it will take parallel to the grain.
(7) Metal is almost perfectly elastic. This quality enables the designer to calculate the stresses to closer limits where deformation is a governing factor which results in a more economical design. An analysis of redundancies by the method of least work is practical where the designer is dealing with metal, but even approximate accuracy is not assured where metal and wood are employed in the same structure or where wood is used alone.
(8) A failure in wood generally results in complete fracture where a metal part would simply be bent out of shape. This quality makes metal much superior in absorbing landing shocks where it is of considerable advantage to hold the machine off the ground after failure of the landing gear.
(9) The fire hazard is not so serious with metal as it is with wood. The loss of life in railway wrecks has not been nearly so great with all-steel railway coaches as it has been where wooden coaches were employed. This is due to the inability of wood to absorb shock, the danger of splintering and the fire hazard.
(10) Wooden airplanes are very costly to maintain in the field. The tendency to warp out of shape makes it necessary to provide means of adjusting the structure in order to preserve the proper alignment.
(11) Protection of wood from the elements is more difficult and at the same time a greater necessity. The absorption of moisture greatly reduces the strength of wood and at the same time increases its weight. Duralumin is practically non-corrosive and steel may be thoroughly protected by galvanizing.

Metal Construction and Future Developments

All of the developments which may be anticipated within the next few years will work in well with metal construction. Flying with supercharged engines and taking advantage of the low head resistance at a high altitude offers a field for transport at speeds far in excess of the highest speed attained by the airplanes of today. The metal monocoque fuselage will offer the only means of furnishing an air-tight compartment with the strength to withstand internal pressure which supercharging will furnish for the comfort of the passenger.

The thick internally braced wing seems to show promise of soon having the field of aeronautics to itself. This type of wing is particularly adaptable to metal construction. The metal wing has the advantages of greater stiffness against vertical and torsional deflection, is more durable, and will not warp out of shape. It has been found impractical to provide adjustable members to maintain the alignment of the internally braced wooden wing, with the metal wing it is unnecessary. The number of rolled sections and stampings which may be used in the metal wing make it particularly adapted to quantity production. The great amount of hand work and gluing in the wooden wing make it unsatisfactory from a standpoint of production.

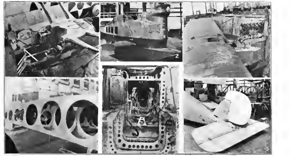
An aerial transport company operating a large fleet of airplanes will be able materially to reduce its overhead if hangar space can be dispensed with and the machines left out in all kinds of weather. This would be impractical with wood as a structural material.

In wartime the airplane was almost invariably crashed long before the question of durability of the structural material became important. The designer of the future commercial airplane, however, will have to give durability much serious thought. The proper use of metal will do much toward prolonging the life of the airplane in service. Fatigue tests indicate that metal will retain its strength indefinitely under repeated stress providing the stress does not exceed 30 to 40 per cent of the ultimate strength. One theory has it that fatigue is a function of the ultimate strength while another theory claims that the elastic limit of the alloyed metal in the annealed condition is the best criterion of the behavior of the heat treated alloy under repeated stress. In either case the result is approximately the same. Ordinary flying loads in bumpy air vary between 0.5 and 1.5g while the designed strength of the commercial plane is sufficient to withstand a load of 6g in most cases. The maximum repeated stress, neglecting the effect of vibration, will be equal to only 25 per cent of the ultimate strength which is well within the limits required by both theories of fatigue. The ingenuity of the designer will be taxed chiefly in guarding against vibration stresses.

The Fundamental Problem of Metal Construction

The design of metal parts which are subjected to nothing but pure tension requires very little thought. It is quite natural that piano wire should have been selected by early designers as the material for tension members because it possessed the highest strength-weight ratio of any available material. But in the design of parts which must withstand compression, bending, or torque much experience and thought are required to utilize efficiently the strength of the metal on account of the tendency of thin sheets to crinkle. The problem of eliminating this tendency is the most important fundamental governing the design of metal airplanes.

Of the various means which have been employed to prevent crinkling probably the most effective and practical is to avoid "match stick" construction. If the number of parts is reduced



Details of Dornier Construction. Fig. 1—Engine compartment and cantilever cabane struts of D1 pursuit plane. Fig. 2—Hull of Dornier Dolphin flying boat. Note longitudinal stiffener riveted to outside. Vertical rows of rivets indicate location of internal stiffeners. Fig. 3—Wing of Dornier Dolphin showing how the duralumin covering is attached. The crinkled appearance of the covering indicates that the covering is extremely thin. Fig. 4—Interior of Dornier Dolphin wing showing flanged bulkheads which function as ribs, and internal stiffeners which are riveted to the covering. Although no internal riveting is required, there is room for a boy to crawl inside the wing. Fig. 5—Interior of Dornier D1 fuselage. The duralumin monocoque construction produces an interior which is unobstructed by structural members. Fig. 6—Tail group of Dornier D1 showing how well the surfaces are faired where they join the fuselage.

to an absolute minimum their bulk may be increased correspondingly. This results in a simpler structure and one less subject to crinkling and to damage in handling.

Next in importance is the choice of materials. Where there is no danger of crinkling the best alloy steel may be employed to good advantage since it possesses the highest strength-weight ratio of any available material. Alloy steel is well adapted to use in bulky members such as wing beams, landing gear struts, axles and engine mountings. Where fragile parts are unavoidable and where it is necessary to use flat plates duralumin is the best material because with the same weight it is possible to have three times as much bulk. If we visualize crinkling in a flat plate as being similar to the buckling of an Euler strut the conclusion is that strength against crinkling is a function of moment of inertia and modulus of elasticity. The modulus of elasticity for duralumin is only about one-third as large as the modulus for steel but for equal weight the duralumin plate may be three times as thick. Moment of inertia is proportional to the cube of the thickness. The net result is that duralumin should be nine times as stiff as steel when used as a flat plate in compression. If we visualize crinkling as pure bending then stiffness is a function of section modulus and ultimate strength. The section modulus is proportional to the square of the thickness. The ultimate strength of duralumin is approximately one-fourth that of alloy steel. The net result is that a duralumin plate should be two and a quarter times as strong in bending as a steel plate of the same weight.

The greatest amount of ingenuity on the part of the designer is required in the conception of structural shapes which will not crinkle. Curved shapes are always stiffer than straight sided sections. The open ends of a rolled or pressed section are points subject to compression failure. The Germans overcame this difficulty in their lattice sections for rigid airships by bending back the open ends so that they came on the neutral axis where the stress is a minimum. Another means of dealing with this problem of open ends is to introduce an eccentricity which will relieve the stress in the open ends of the angle or channel, and increase the stress on the opposite side where there is considerable curvature. The flat plate may be stiffened in many cases by the use of flanged lightening holes. Where this is impossible stiffeners may be riveted to one side of the plate or stiffening ribs may be beaded into the surface.

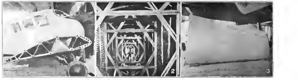
General Considerations

The joining of metal parts, although much simpler and more efficient than is possible with wood, still is attended by difficulties. Welding makes it impossible to retain the full strength of heat treated metals and the efficiency of the welded joint depends too much upon the skill of the workman. Brazing has won general recognition for greater dependability but falls short on the requirement of strength. Brazing spelters have been developed which permit the heat treatment of the steel parts after brazing, but it is impractical to heat-treat large and unwieldy assemblies. Soldering after heat-treatment requires even larger and heavier joints than is the case in brazing. Riveting heat treated parts together is an ideal assembly from the standpoint of production as it is a cold process and clean. Unfortunately a riveted joint cannot be made with perfect efficiency as referred to tension members unless an expensive process of forming the parts is resorted to. Everything considered, joining by means of rivets and gussets is probably the most satisfactory method. This method has withstood the test of years in structural steel work and has been employed with considerable success in airplane construction.

The fuselage constructed of welded steel tubes is not practical from the standpoint of production. Alignment cannot be assured even if the tubes are held in a jig during the welding operation as it will immediately spring out of shape when it has cooled off and the jig is removed. Fokker overcame this difficulty in the D-VII by adhering to the "stick and wire" principle. The frame of tubes was first welded

together in a jig. When the frame was taken from the jig wires and turnbuckles were provided which pulled the structure back into shape. There is much well founded prejudice against relying upon welding for tension stresses and Fokker conformed to this principle as far as the struts and longerons are concerned but violated it by welding on the terminals to which the wires are attached.

The metal monocoque type of fuselage has several important advantages. A perfect streamline shape may be produced as cheaply as any other shape. The interior is not obstructed by structural members and the maximum space is provided for passengers or freight. The method of fabrication is quite simple. The metal monocoque fuselage if it is to be structurally efficient must be provided with closely spaced circumferential stiffeners which are usually rolled sections and may be produced at little expense. Longitudinal stiffeners also add to the structural efficiency but add to the skin friction and induced drag if placed outside. In the well designed fuselage the metal covering is counted on principally to withstand the tension and shear while the stiffeners take the compression stresses.



Details of Junkers construction Fig 1—Front portion of fuselage, showing wing root construction and fuel tank Fig 2—Interior of fuselage The corrugated covering makes the use of longerons unnecessary Fig 3—General view of the wing, showing corrugated duralumin covering and tapered form of wing

Uses of Steel Tubing

The tubular steel engine mounting is undoubtedly the most satisfactory type which has been developed and is used extensively even with the wooden fuselage. All parts of the engine are easily accessible when the cowling has been removed. The installation may be so designed that the whole power plant may be detached by simply removing four bolts and disconnecting the engine controls. The inserts for bolt holes at the strut ends should be riveted and brazed in place. The metal monocoque construction should not be extended to support the engine. Accessibility would be sacrificed and the effect of vibration upon thin sheet metal should preclude its use for strength members in the proximity of the engine. The monocoque construction may be conveniently stopped at the fireproof bulkhead which should be placed just aft of the engine compartment.

The steel tube has been the standard material for axles from the very first. In recent years the development of the alloy seamless steel tube has enabled designers materially to reduce the weight. At present the steel tube is rapidly replacing wood as the material for landing gear struts even on wooden airplanes. The ease with which tubes may be telescoped makes them ideal for installations where the shock absorbers are placed either on the struts or inside the fuselage or wing. This arrangement makes it possible greatly to increase the displacement of the shock absorbers without reducing the ground clearance of the axle. This is particularly desirable on large machines where the size of the wheels and tires may be materially reduced and the whole landing gear lightened on account of the increased ability to absorb shock. The elimination of spools and shock absorbers at the attachments of the struts to the axle permits catching the axle close up to the wheel and makes possible the use of a much lighter axle due to the reduced bending moment. The whole arrangement is much simpler than the old wooden landing gear and offers less head resistance. Another advantage of the metal landing gear has been mentioned before, its ability to withstand considerable distortion without fracture.

Metal vs. Fabric Covering

The choice between metal and fabric for covering wings has never been definitely settled. A fabric covering if properly protected against the rays of the sun by the use of pigmented dope will last at least a year in service anywhere except in the tropics. The thinnest sheet duralumin which it is practical to roll weighs much more than doped fabric. The duralumin covering may be of metal [illegible] to replace two important structural elements, the ribs and the drag bracing. The metal covered wing generally presents difficulties in assembly due to the fact that rivets must be backed up from the inside. A notable exception to this is the Dornier CS2 in which the wing covering is riveted on from the outside. Each rivet catches the rib, two flanged edges of the covering and a light channel which finishes the flanged edges and helps to hold them together. Light stiffeners inside the covering bridge the space between the ribs and permit a wide rib spacing. In the Junkers wing the corrugated covering together with multiple spars eliminates the necessity for ribs. It is doubtful if this arrangement accomplishes any real saving in weight however. The corrugated covering is about three times as heavy as doped fabric. The corrugations seriously impair the effectiveness of the covering as drag bracing. That metal ribs can be made extremely light was demonstrated by a recent duralumin rib with a 75 in. chord and which stood a load factor of twelve with a weight of only 6 oz. as compared to 12 oz. for a wooden rib of less strength.

Another advantage claimed for the metal covering is that it can be made to assist the wing beams in carrying their load. That this advantage is only partially realized in practice has been proved by tests with stiffeners which were developed to prevent crinkling in a cover plate. These stiffeners proved to be much more efficient columns when tested alone than when combined with a narrow flat plate riveted in place. It has become an axiom in metal construction that thin flat plates are to be avoided wherever possible. Curvature is the surest provision against crinkling. The fact that the full depth of the wing section may be utilized for beam depth in the metal covered wing is generally a more important consideration than the actual strength contributed by the covering. The covering acts as a gusset plate to carry the rib stresses across the beam without the use of deep capstrips.

A very important consideration in the design of internally braced wings is provision against torsional deflection. In a nose dive there is a strong torsional load on the wing which is resisted by the tail. Any torsional deflection tends to reduce the angle of attack at the wing tip and this increases the download on the tip of the front wing beam, thus aggravating the condition. The most effective way of resisting torsion in a thick wing is to provide two sets of internal drag bracing, one near the upper surface and one near the

bottom. This makes the beams and drag bracing, in effect, a rectangular tube. This principle is well worked out in the duralumin covered wing where the covering assists the beams in carrying their load, forms the drag bracing and helps to distribute the load between the beams by resisting torsional deflection. An excellent example of this type of construction is the Dornier D1 in which three closely spaced beams are employed, taking advantage of the full depth of the aerofoil, the middle beam being at the maximum ordinate. Sand loading on a wing of this type shows that there is actually no torsional deflection when the load is not symmetrical with the beams.

Increasing Number of Metal Members in Wooden Airplanes

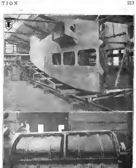
In early airplanes practically the only metal members outside of the power plant and controls were the wheels, axle, wires, and fittings. Metal parts have gradually replaced wood, however, and at the present time it is quite general practice to use metal for the majority of parts even in the so-called wooden airplane. It is not at all uncommon to find in the so-called wooden airplane the following metal parts: landing gear, engine mounting, fireproof bulkhead, a few fuselage struts, tail post, tail skid, tail surfaces, ailerons, interplane struts, wires, and fittings, practically the only wooden members being the fuselage framing, the wing beams and the ribs.

The use of the seamless steel tube for struts and torque tubes was the first decided step toward metal construction. The steel tube was readily utilized by the designer, first, because it was ideally adapted to the purposes to which it was put and, second, because it was already a standard product and could be easily obtained. The faired steel tube is particularly advantageous for struts which are exposed to the air stream because the large radius of gyration of the tube and the high modulus of elasticity of steel permit the use of a narrow strut. It is quite generally believed that there is no advantage in using alloy steel for long struts since the theoretical strength of the long strut is a function of the modulus of elasticity which is the same for all steels. This contention, however, has not been supported by tests which show that the alloy steel tube has a higher average strength

Interior of Junkers wing, with the upper surface removed to show construction. The duralumin covering is attached to the longitudinal tubes (also shown in Fig. 1, p. 212) by riveting. A special tool was used to buck up the rivets inside. The tubes are cross braced by U section strips with flattened ends and riveted. The fittings painted black are of steel

than mild carbon steel in long struts. This is particularly true with thin walled tubes where alloy steel seems to be less subject to crinkling and is not so easily dented by rough handling. For short struts, torque tubes and tension members there is no questioning the superiority of alloy steel. For members which are alternately subjected to tension and compression, the interplane struts of a Warren wing truss for instance, the steel tube is practically the only thing that has ever been used.

The duralumin tube is now available in this country and is well suited to use for struts where there is no aerodynamic restriction on the diameter. The diameter of the duralumin strut may be larger than that of a steel strut where a limit must be placed on the thickness of the wall to guard against crinkling. Any increase in diameter means an increase in the radius of gyration, a higher allowable average stress and consequently a lighter strut.



Zeppelin-Staaken construction—Above, the fuselage with a wing root, below, the fuel tanks mounted in the wing

Materials and Processes Available

Almost any material or process which it is possible for science to produce may be obtained if the demand is insistent. A great obstacle in the way of airplane development has been the fact that except in wartime the demand for airplane materials of construction has been in quantities too small to make production profitable. The aircraft manufacturer who required special alloys of steel and aluminum and who insisted upon close tolerances in chemical composition, condition and dimensions was generally compelled to pay a very high price. In most cases he has had to beg the vendor to do business with him at any price. There have been a few manufacturers however who have considered that it was to their best interests to serve the aircraft trade. The result has been the same whether they believed in the future of the airplane or whether they saw in this service an opportunity to develop materials which might find a market in other lines of endeavor.

The steel wire and cable were among the few metal parts on the early airplane. The steel wire and cable were and still are furnished principally by the John A. Roebling's Sons Co. of Trenton, N. J.

The American Steel and Wire Co. of Pittsburgh, Pa., is another producer of aircraft wire.

The Waterbury, Farrell Foundry and Machine Co. of Waterbury, Conn., has developed a process whereby threads may be rolled on wire ends which results in a much smaller reduction in strength than is involved with cut threads. The rolling process removes none of the material and the section at the root of the threads is the maximum that can be obtained without upsetting.

The Stewart Hartshorn Co. of Jersey City, N. J., have been pioneers in the development of streamline wires in this

country. This type of wire has been used extensively even in unexposed places on account of its great strength and the ease with which it may be adjusted

The Ohio Seamless Tube Co of Shelby, Ohio, has done much to cooperate with the aircraft industry by developing the alloy seamless steel tube On account of the hardness of alloy steel it has been very difficult to draw thin walled tubing with this material and a considerable amount of experimental work has been required This company now carries in stock a great variety of 3½ per cent nickel, 25-35 carbon steel tubing in gages down to No 22 B W G (0 028 wall) This tubing may be heat-treated to give a strength of about 150,000 lb per sq in and may safely be counted on for a minimum strength of 125,000 lb per sq in Chrome vanadium steel tubes with a probable strength of 175,000 to 200 000 lb per sq in are listed as special and may be obtained if ordered Thick walled axle tubing with a strength of over 200,000 lb per sq in has been available for some time

Snead and Co of Jersey City, N J., are employing an electrical method of heat-treatment for tubes which is very ingenuous The process besides heat-treating also straightens out any curvature which might exist Unfortunately there is a short length of waste material created at the ends of the tube which makes this method impractical for tubes which have already been made up

It has been difficult to obtain the best steel in thin gage tubes because they are difficult to draw with the result that the strongest steel was only obtainable in thick gage tubing. The reverse is true of steel strips however The best alloys may be used in all gages but the working of the steel in thin gages increases its strength It is also possible to obtain uniform heat treatment all of the way through.

Quite a large number of steel manufacturers have furnished steel bars, rods, strips and sheets to the aircraft trade Notable among these are the following Crucible Steel Company, Pittsburgh, Pa., Halcomb Steel Company, Syracuse, N Y., Bethlehem Steel Company, Bethlehem, Pa., La Salle Steel Company, Chicago, Ill.

The Gallaudet Aircraft Corp of East Greenwich, R I, has built at considerable expense a special furnace with which it is possible to heat-treat an assembled wing beam This furnace is available to other manufacturers who are unable to heat-treat long assemblies in their own plants.

The Aluminum Company of America, Pittsburgh, Pa, has produced aluminum alloy sheets, strips, bars and rivets for some time and have recently added tubes to this list.

The Bausch Machine Tool Co, Springfield, Mass., has furnished duralumin in sheets, strips, bars and in fabricated parts, including forgings and die-castings

A notable gap in the list of available materials for aircraft is the alloy steel rivet One aircraft manufacturer was driven to turning rivets down from rods while another induced a wire manufacturer to furnish an alloy wire which he made into rivets by an upsetting process. This latter process probably produced the better rivet

The fact is so self-evident that an apology is offered with the statement the demand for the airplane in large numbers is the only thing which will greatly reduce production costs all of the way from the raw material to the finished product. The result would be a lighter, stronger and more efficient airplane

Danish Air Line

The *Danske Luftfartselskab* or Danish Airway Co will inaugurate an aerial service between Copenhagen and Hamburg in April, with a two-hour flight schedule between these cities, Consul General Letelier reports to Commerce Department. Definite details have not been announced. The new air connection is believed to be a replacement of one proposed last year between Copenhagen and Berlin, which is said to have been abandoned "because of higher cost by 25 per cent and the greater risk through wider water crossing"

A similar service will be undertaken at the same time between Malmoe, Sweden and Hamburg, via Copenhagen A regular service is proposed between Malmoe and Copenhagen across the sound (Oresund), which separates the two cities, this to be at a cost of ten Swedish kroner Trips will be made in seven minutes The present ferry time schedule is 1¼ hr The fare from Malmoe to Hamburg will be 50 Swedish kroner, it is reported

In Danish service native fliers as well as Danish machines will be employed. The company expects to receive a subvention from the Government equal to that provided last year but not received because of abandonment of Copenhagen-Berlin route plans The former grant was 110,000 kronor

Gothenburg Aero Exposition

An official invitation has been sent by the Swedish Foreign Office to the United States to participate in the International Aero Exposition, which will be held at Gothenburg, Sweden, from July 20 to Aug 12, this year, under the auspices of the Royal Swedish Aero Club and in connection with the 300th anniversary of the founding of the city of Gothenburg, Sweden's chief sea port

Maj Gen Mason M. Patrick, Chief of Air Service, War Department, has already advised that Major Foulois, air assistant to the military attache in Berlin, will be authorized to attend the exhibition The Post Office Department is preparing an exhibit both the War and the Navy Departments are interested and it is possible that an exhibit may be prepared with a view to transportation on a battle ship or other government vessel

As an assurance to the American aircraft industry that their interests will be taken care of in the best possible way the exhibition authorities have not only reserved a special section for a composite American exhibit, but have officially invited the Aeronautical Chamber to send a representative to Gothenburg who would look after the American exhibits and generally act as agent for the American aircraft industry, the transportation of this representative to Sweden and return to be borne by the Exposition.

France, England, Germany, Sweden, Holland, and Italy have already entered about 30 planes to participate in the flying contests, and space has been reserved in the exposition by various governments and by such aeronautical firms as Caudron, Nieuport, Breguet, Aera, Olivier, Levasseur, Hispano-Suiza, Hanriot, Vickers, Rolls-Royce, Junkers, Dornier, Wiggand, Fokker, Napier, Caproni, etc.

Flying competitions of unusual interest have been arranged, and more than 70,000 Swedish Kroner will be distributed in prizes. These competitions include a 900 kilometer arrival contest, contests for air traffic planes, for sporting or tourist planes, for foreign military fliers, squadron flying for military fliers, relay flying, bomb throwing, high altitude contest, etc.

Coincident with the exposition there will be held an Aeronautical Science Exposition under the direction of Dr Ivar Malmer, Professor of Aeronautics at the University of Stockholm, and this as well as other kindred exhibitions will give a highly educational and interesting illustration of the history and recent development of aerial navigation, including commercial, military and postal aviation

It is an important fact that the *Federation Aeronautique Internationale* will hold its annual meeting in Gothenburg at the beginning of August An International meeting of aviation insurance people, and several other meetings of great importance are also scheduled to be held during the exposition.

This exposition offers an excellent opportunity for American aeronautical interests to compete with European manufacturers and aviators, and it is hoped that representation can be furnished. American participation is particularly advisable because of Sweden's geographic position and actual prominence as an intermediary for American business in Russia and the Baltic States Commercial aviation is well advanced in Europe, and this exhibition should do much to cause its increased adoption in the Scandinavian countries

Exhibits have been granted a 50 per cent reduction from regular rates, both going and returning, when shipped by the Swedish American Line

A handsome booklet on aviation matters in general and on the exposition has been issued and copies can be obtained from the Swedish Chamber of Commerce of the U S A., or from the Aeronautical Chamber of Commerce of America, New York

The Story of Transportation by Air

Review of the Development and Application Of Aircraft to Purposes of Transportation

By Comdr. J. C. Hunsaker, (C.C.), U.S.N.

At Versailles, on Sept 19, 1783, the King and Queen, the Court, and a vast throng of people of every rank and age assembled to witness the ascent in Montgolfier's hot-air balloon of a sheep, a cock, and a hen, the first aerial passengers The experiment proved an astonishing success although the sheep is alleged to have trampled on the cock before the balloon came to earth two miles away Two months later, Pilâtre de Rozier and the Marquis d'Arlandes sailed aloft before the eyes of a delighted multitude in a similar balloon. The American Ambassador, the venerable Benjamin Franklin, observed proceedings from his carriage and, as the foremost scientist of the day, was besieged by the ladies to explain what use would come from the new invention Tradition has it that he replied with characteristic caution by asking "What use is a new born infant?"

What Benjamin Franklin Wrote

In a letter to a friend in Philadelphia, Franklin wrote—"Among the Pleasantries Conversation produces on this subject, some suppose Flying to be now invented, and that since Men may be supported in the Air, nothing is wanted but some light handy instrument to give and direct Motion. Some think Progressive Motion on the Earth may be advanc'd by it, and that a Running Footman or a Horse slung and suspended under such a Globe so as to have no more of Weight pressing the Earth with their Feet, than Perhaps 8 or 10 pounds, might with a fair Wind run in a straight Line across countries as fast as that Wind, and over Hedges, Ditches & even Waters. It has even been fancied that in time People will keep such Globes anchored in the Air, to which by Pullies they may draw up Game to be preserved in the Cool & Water to be frozen when Ice is wanted. And that to get Money, it will be contriv'd to give People an extensive View of the Country, by running them up in an Elbow Chair a Mile high for a Guinea, &c. &c B Franklin."

One hundred and twenty-five years later, Orville Wright in the presence of the President of the United States, his Cabinet and all official and unofficial Washington, flew in an airplane with a passenger for over an hour The public was, of course, astonished and, no doubt, the ladies clamored to know what it all meant

The inventions of the Montgolfier Brothers and of the Wright Brothers mark the two epochs in man's conquest of the air The Great War brought perfection to each, in the form of the Zeppelin airship and the modern airplane, respectively We are now in possession of these two fundamentally different means for transportation by air of proved utility for military purposes, but not yet applied for commercial purposes. The Nineteenth Century was an age of steam, and the social organization of the civilized world was profoundly altered by the extension of steam transportation by land and sea Is it likely that the Twentieth Century will be as deeply marked by the extension of air transportation?

The first *montgolfieres*, as hot air balloons are still called, have not in fact proved of great utility, notwithstanding that Gambetta did escape from besieged Paris in a balloon, and that small boys of the last three generations have been entertained at county fair balloon ascensions by "Cap" Tom Baldwin in pink tights and spangles Nevertheless, the free balloon remained until our century the only practical vehicle to take a man into the air if he have business in such regions. By means of it, and its devotees of sporting blood, we have derived a large part of our modern, if inadequate, knowledge of our upper atmosphere, its clouds, storms and the lightning

From the Balloon to the Airship

More directly from the free balloon the dirigible balloon, or airship, was developed in France after 1880 by Col Renard and his followers in order to obtain a vehicle of value to the Army when the next war with Germany should come Also, von Parseval and Zeppelin in Germany developed their airships with a like object in view Expected war and the modern scientific method turned the balloon into an airship in time to be applied for destructive ends in 1914 During the War, airship development made greater progress than in all the preceding century, but with this stimulated progress there were heavy airship casualties due to its new rival the airplane, assisted by its old enemy the weather

At the end of the War, it was clearly established that for convoy duty and submarine searching the small non-rigid airship was really useful, and that for long overseas scouting flights the large rigid airship or Zeppelin was of value On the other hand it was equally clearly established that airplanes, if available, could shoot down any airship, and that to execute a policy of *schrecklichkeit*, bombing airplanes could be even more *schrecklich* than Zeppelins. By 1918, the Germans confined their Zeppelins to scouting operations over the North Sea to keep watch over the movements of the Grand Fleet and certain units of the Grand Fleet employed themselves cruising over the North Sea with airplanes on deck ready to take the air hunting for Zeppelins The game resembled falconry, the hawk on wrist being the airplane which was having decidedly the better of it At this stage, the airships were filled with highly explosive hydrogen, and were an easy prey for airplanes. However, the quantity production in the United States since the war of non-explosive helium gas has changed the rules of this game of airship *strafing*, and the position now is not so clear

Obviously, the helium airship is enormously safer and, hence, more valuable for naval and military purposes while its commercial utilization is now justifiable The flight of the British airship R34 across the Atlantic looked like the proof of the pudding, but the more recent catastrophes to R38 and to the Roma, neither one using helium, have, so far as the public is concerned, effectively spoiled it Several projected commercial airship lines have had to be abandoned or put in cold storage Yet, the airship is a fact, and it is also a fact that no new means of transportation has been permanently abandoned because of disaster in the early stages of development. The loss of the Titanic did not stop the development of gigantic fast liners, nor did the collapse of the Quebec bridge cause a boom in the construction of ferry boats

How the Airplane Developed

Let us leave the airship as a war developed aircraft and consider the airplane This likewise obtained the greater part of its development during the war From 1908 to 1914, airplanes had followed the perfection of the gasoline engine and had grown consistently faster and more reliable The scientific and engineering side of aerodynamics had been painfully perfected during these years, and by 1914 the art had definitely emerged from the field of invention into that of engineering. The fruits of six years' thought was applied under the stimulus of war conditions with unlimited funds and personnel, and results were immediate. In fact, progress in aviation was so rapid, relative to that of other arms, that by the time the United States entered the war, our public expected the impossible. The impossible was put into concrete form as an impossible airplane building program by enthusiasts in high places who preached that "aviation would win the war" Naturally, the program as a whole, proved a failure, and the public, also very naturally, was thoroughly disgusted

This attitude changed in 1919 when it was realized that while the impossible Army program was never met, nevertheless a very creditable effort was made; that the Liberty engine production was a real achievement of which the country could well be proud; that an enormous number of aviators

were trained on American-made airplanes and did splendid work at the Front on machines purchased abroad, and that the Navy's more modest aircraft program went through without a hitch

Together with the reaction from this first disappointment came an appreciation of the really very great possibilities of the airplane as a means of transport The country was flooded with stock promotion "literature" of gentlemen who were quick to capitalize this public interest. Then followed an epidemic of failures of air transport concerns Some ought to have failed owing to the conditions of the promotion Others were legitimate enough, but failed due to the unsuitability of their equipment, lack of adequate terminal facilities, and insufficient patronage

A post mortem on commercial aviation in 1924 would not prove interesting What is really interesting is the record made in 1921 when the momentum of war activity had largely run down The extravagant and wasteful methods proper to war operations were unlearned, the gross recklessness of fighting aviators was curbed, and the airplanes used in the war were modified to suit them to commercial purposes.

Some Data on Airplane Operation

Statistical data compiled from available published sources do not give the whole story. The Army and Navy train new pilots, engage in flights over dangerous country by day and night, execute combat maneuvers in formation, exercise in acrobatics and, in general, take every risk possible except that of defective equipment Commercial flying abroad is subject to government inspection and licensing regulations, but in this country it is quite unrestricted Any person may buy a condemned airplane at an auction of government war surplus and proceed to offer his services to the public The itinerant or barnstorming aviator is a menace to the lives of those who ride with him and those who are so unfortunate as to dwell under his route In this country there is today only one established air line maintaining a regular schedule between well equipped terminals, and using first class equipment and competent personnel This line reported the following operating results covering the period November 1921 to March 1922 —

Flights completed on schedule	735
Flights delayed by weather	5
Accidents	0
Passenger-miles	256 825
Hours in the air	840

This perfect record was made in Florida and naturally the weather conditions are exceptionally favorable

However, consider the record of the U S Post Office Department, Air Mail Service, run for a full twelve months between New York and San Francisco Here every condition of wind and weather was encountered —

Trips scheduled	8 298
Trips completed as per schedule	7 878
Trips uncompleted	211
Trips defaulted	341
Miles traveled	1,537,927
Hours in the air	19,039
Serious injuries	None
Killed	None
Number pieces of mail carried	49,880,456

The following table summarizes the hazards of flying in a gross manner —

	Flying hours	Killed or Injured	Flying hours per casualty
French commercial 1921	18 017	32	1,126
Belgian commercial 1921	2,411	5	803
British commercial 1921 22	6 537	6	1,085
U S Commercial 1921	70 571	136	473
U S Army 1921 22	70 246	58	1,524
U S Navy 1921 22	36,048	20	2,763
U S Post Office 1921 22	19 060	0	

Safety Record of the Air Mail

Note that military and naval flying which one might expect to be more dangerous than commercial flying is in reality less so, while the Air Mail, taking all hazards of weather, proved the safest of all by an enormous margin The conclusion seems to be that commercial flying is unnecessarily dangerous and that American commercial flying is excessively bad and in need of regulation

Today we have a situation in which it has been clearly demonstrated that aviation, properly applied, can transport passengers or mail over land or water more quickly than any other agency known to man, at a reasonable cost, with considerable reliability, and with slight risk of accident On the other hand, the public remains frankly skeptical Passengers except for the joy riders who try anything once, will not use an airplane unless the rail or steamer service is painful (London Paris, Key West Havana, Berlin Moscow) Capital will not support commercial aviation enterprises from lack of evidence of money-making possibilities Without capital the safe extension of commercial aviation cannot take place, and without public confidence and support present enterprises will not prove attractive as investments

This situation is one that requires only time to clear up It is not a question of a deadlock with the next move clearly up to someone Perhaps the most unfortunate thing for American commercial aeronautics would be a premature expansion, such as was attempted immediately after the war For example, a paralyzing railroad strike such as took place in Germany would automatically bring out any quantity of unsafe and rickety airplanes to solicit the patronage of those requiring immediate transportation With the present complete absence of governmental restrictions on interstate air traffic, there would be a heavy loss of life

The Need of Air Legislation

Airplanes of sound design and construction in the hands of competent pilots, with a comprehensive ground organization for inspection, repair and maintenance, and with an adequate chain of proper landing fields can today give very safe and reliable service But until necessary legislation is passed by Congress, "Let the buyer beware" applies with great force to the person who buys a ticket for an airplane trip

Such conditions will quickly be cured by legislation now pending to establish in the Department of Commerce a suitable regulating and licensing authority Granted such control, wisely administered, only trustworthy aircraft will be available for passenger work, and it should be only a question of time until their record of safe and reliable operation will earn the confidence and the regular patronage of the public.

But time is necessary The habit of making haste is one of the lessons of the war which American Aviation must unlearn. The development of entirely suitable aircraft which will be both safe and profitable for commercial purposes will be a slow and methodical evolution from the war types, and must be based on actual experience and on patient engineering research. There are aircraft available now which can and do give safe and reliable service under favorable conditions, but yet would prove to be unprofitable on account of high costs. What we will have are aircraft and engines of low maintenance cost and long life. The airplanes developed for war work are commercially speaking "gasoline eaters," having excessive power, low carrying capacity, fragile construction, and high landing speed. The engines after 75 hr need complete take down and overhaul, and the airplanes rebuilding after 200 to 300 hr

The evolution of a sound design and type of construction for commercial purposes is really going on now It is not a matter of invention, but one of engineering skill applied to experience gained from actual operations. Not that inventors are not needed; there are already a number of inventions which, if successfully worked out, will materially simplify the problem But there is no outstanding invention that needs to be made for a cure all In the war, we learned that officially appointed committees of inventors proved quite sterile, while useful ideas and inventions occasionally cropped up in unexpected places Aircraft engines built today have double the life of war built engines and consume 20 per cent less fuel for given power

The Question of the Commercial Airship

The successful commercial airplane is nearer at hand than the airship. The problem of the commercially profitable airship in the present state of our knowledge seems to resolve itself into these considerations —

(a) The airship will be of the rigid or Zeppelin type, of large size and capable of covering a distance of several thousand miles Its cost will be measured in millions of dollars

(b) The housing, handling and docking facilities at terminals must be extensive, with a cost measured in millions.

(c) The airship in the interest of safety should be inflated with helium, which is in limited supply in Texas and Oklahoma only, and costing today some quarter of a million dollars every time the ship is inflated

Doubtless the costs of ship and helium will come down as new processes and methods are discovered Already the development of a special mooring mast make it possible to eliminate expensive docking facilities except at the home port But in general, the commercial utilization of airships is an enterprise involving such an outlay of funds that it is unlikely that private capital will take the risk without some form of Government guarantee or subsidy The merits of such a subsidy scheme can be shown to have force, but the necessity for raising this question illustrates the difficulty of reaching a conclusion as to the commercial practicability of airships by actual operations

Something toward an answer to the question may be obtained by experience with the "reparations" airship which Germany is to deliver to the United States This airship must be delivered by Germany as reparation for airships illegally destroyed in Germany after the Armistice, which airships had been allocated to the principal Allied and Associated Powers The ship of 70,000 cubic meters volume is now under construction at the expense of the German government by the Zeppelin company at their works at Friedrichshafen, under the supervision of an officer of the Construction Corps, U S Navy The airship is limited by decision of the Council of Ambassadors to a "civil type" and as such will not be a duplicate of the ships destroyed, but a new design arranged for passenger service Cabin and messing facilities for thirty passengers are provided. The contract provides for delivery by the builders to the U S Naval Air Station, Lakehurst, N J, after a trans-Atlantic flight The fact that such a contract was accepted speaks volumes for the confidence of the Germans in their product

The Flying Boat Justifies Itself

The use of flying boats for commercial transport service seems to be attended by the fewest difficulties and in the Key West-Havana line has already justified itself. Without government assistance of any kind, this line has maintained a regular service using flying boats equipped with twin Liberty engines. These boats were used during the war by the Navy for anti submarine work and were sold to the company who rebuilt them to accommodate passengers instead of depth bombs

A flying boat service needs only a good harbor at each end of the line and docking facilities at one end The harbor costs nothing and the docking facilities are not expensive. No landing fields are required and it only remains to find more cities of adequate size between which there is a demand for more convenient and rapid transportation Obviously, ice and winter weather in the North will stop operations just as they do with vessels, but the greatest competitor is the Pullman car If the run can be made overnight on a good train there is no real demand to fly it in 3 or 4 hours, spoiling a business day

The perfection of night flying in the not distant future will change any final conclusion that one would reach from a consideration of the present state of the art So long as trains run by night and airplanes only by day, the plane has too great a handicap to compete for intercity business in the interior of the United States The Post Office Department is now operating a successful daylight air mail service which it has been proposed to extend over part of the New York San Francisco route to include a night run The successful demonstration of night flying by the Air Mail will put in the hands of commercial air transport concerns data, methods and equipment which should facilitate the rapid extension of night flying, and consequently enable the airplane to compete on equal terms with trains

Airplanes also have the excellent rail service between our principal cities to contend with and in addition they need access to large landing fields not too far out of town, intermediate landing fields en route for use in case of a forced landing, a low landing speed to reduce danger, and means for collecting passengers and goods from the center of the city The London Paris lines have free access to government landing fields suitably equipped outside London and Paris and, in addition, enjoy a generous government subsidy, together with a special meteorological service with fog and navigational signals by radio However, the airplanes have to fly over the Channel and over rough country and to date there has been several serious accidents The airplanes would require wide smooth fields for landing

In the United States no one firm running a commercial airplane service could afford to tie up the necessary capital to provide landing fields, and there are not enough firms to permit communal occupation Suitable landing fields must be made available by municipalities before a serious effort can be expected

Advantages of Large Flying Boats

As to the airplanes themselves, it would seem obvious that a few large airplanes seating from ten to twenty passengers each would require less overhead and be cheaper to operate than a fleet of small planes seating four to eight passengers. However, this is not likely to be the case, due to landing conditions. The large airplane is more difficult to land safely on a given landing field and for this reason cannot be fully loaded Where a two ton airplane can safely be landed at 55 m.p.h., a six ton airplane will surely smash up A forced landing in somebody's pasture presents no abnormal hazard to the two-ton airplane, while the six-ton plane has little chance of landing safely and none of getting into the air again Consequently, the large airplane must be kept to a lower landing speed than the small one, which entails less load, or larger wings, and consequent poorer economy For the flying boat this restriction on size does not apply The larger the flying boat the faster it may be set down on the water without danger

During the war the landing speed of airplanes was increased from about 40 m.p.h. to nearly 60 m p h as the skill of pilots increased, in order to gain the military advantage of maximum full speed Simultaneously, landing fields were made larger and smoother

To justify its existence, airplane transport must be fast. This again requires high power, low resistance, and in the present state of the art, small wings and relatively high landing speed This condition, while inherent in design, is in no sense absolute.

In the past two years great progress has been made in increasing the "speed range" of airplanes, that is, the spread or range between the lowest flying speed, or landing speed, and the maximum full speed This improvement has come first by the discovery of wing shapes of better efficiency and lower resistance, lighter engines, and in general by better design In 1918 a full speed double the landing speed was considered excellent. Now the full speed can be made three times the landing speed. New forms of wings are under investigation which should still further improve matters It is certain that progress in airplane design is continuous and the possibilities of commercial airplane transport are not to be judged entirely on past performance

It is futile, however, to discount future developments prematurely We have had enough of that Unwarranted predictions by alleged experts who neglect to set a time limit have done a great deal to discredit commercial aviation in the eyes of the public. What we do know is that the air mail operates with existing planes and engines with splendid success

Long Flights of Naval Seaplanes

Further, we know that last spring the Torpedo Plane Squadron of the Atlantic Fleet, consisting of eleven seaplanes flew from Hampton Roads to Key West, conducted maneuvers there and returned without a casualty, the complete cruise totaling over 2600 miles. Again, during the last combined maneuvers of our two main fleets, the Atlantic Fleet Aircraft Squadron of nine flying boats flew from Philadelphia to Panama and returned, a total minimum distance of 6,200 miles, while at the same time the Pacific Fleet Aircraft Squadron of fourteen flying boats made the trip from San Diego to Panama and back again a total of about 6,200 miles Neither Squadron reported serious injuries of any kind.

These are the authentic records of large-scale operations and illustrate the safety and dependability of flights conducted

under more adverse conditions of weather, supplies and maintenance facilities than any commercial venture would have to face. Of course, nothing is proved as to the profit and loss side of the matter by these naval operations.

Profitableness depends to a large extent on how much the public will be willing to pay for speed. There is every reason to believe that the American business man values his time, even when playing, at a very considerable sum, and once satisfied as to safety and reliability, the expense of a 3-hour trip by air should not induce him to suffocate in a Pullman, or take his chances with a steamboat for 12 hr.

The question of what rate the traffic will bear is again one awaiting practical test, but the experience of the Agricultural Expert should be kept in mind. The A. E. advised a Georgia darky to soak his corn before feeding his hogs as the hogs could then digest it in half the time. The darky replied—"Boss, up Norf where you comes from, what do you reckon a hog's time am wurf?"

Mapping Tennessee from the Air

The growing importance of aerial photography in its relation to rapid and accurate map making is well illustrated by a recent report of the Engineering Division, Air Service. This report covers the operations of a photographic mapping expedition to the State of Tennessee, which was directed by Capt. A. W. Stevens of the Aerial Photographic Branch of the Engineering Division, with Lieut. George W. Polk as pilot.

During the course of two months Captain Stevens exposed, developed, numbered, plotted, and printed negatives covering 5000 sq. miles of the State. A flying field was selected near Tiptonville, Tenn., and a laboratory set up in the village. From this point as a base, photographic work was carried out in the northwestern, southwestern, and central parts of the State.

The region known as the Reelfoot Lake area, which comprises 630 sq. miles and extends from the foothills on the east to and including the Mississippi River on the west, was photographed first. Two photographs were made of it, one from an altitude of 15,000 ft. with a K1 camera fitted with a 12-in. lens. The other was made from an altitude of 16,000 ft. with a Tri Lens camera, using 6½ and 7½-in. lenses. Ammonized panchromatic film was used entirely, with ray filters which excluded blue rays altogether and thereby eliminated the effects of aerial haze.

An area of 1300 miles, embracing the Mississippi River from New Madrid, Mo., south to the Tennessee-Mississippi State Line, was next flown over and photographed, the F1 camera being used.

The third area was that of the Memphis Quadrangle, which was photographed twice from an altitude of 16,000 ft. The T1 camera was used in making the first photograph, and the K3 camera in making the second.

The expedition then photographed the Nashville 30-min. Quadrangle, which embraces four times the area of the 15-min. Quadrangle, or nearly 950 sq. miles. It also covered 480 sq. miles of the valley of the Cumberland River, and 180 sq. miles of the valley of the Harpeth River. It is interesting to note that in two successive days, Sept. 30, and Oct. 1, the 1610 sq. miles were covered.

On Oct. 1, 1010 sq. miles were covered in 4 hr. 50 min. flying time, with the T1 camera, from an elevation of 16,000 ft. At this elevation the width of the country covered in one strip by the camera is ten miles. Although the weather was extremely hazy (the visibility being only 8 miles), there was no difficulty in cutting the haze for a distance of 5 miles each side of the airplane with the film and filters described above.

The Reelfoot Lake Area is particularly interesting from the standpoint of a geologist, as the lake was formed in 1812 by one of the greatest earthquakes of modern times. If such an earthquake were to occur today, it is estimated that ten times the damage of the San Francisco quake might be inflicted. In the early days of the country the region was sparsely populated, but now there are many towns that might suffer total destruction were such a disaster to happen again. The whole lake region is low and marshy, and a survey of it on the ground would be both difficult and expensive; for these reasons it was decided to cover it by photographs made from the air. The U. S. Geological Survey now has these photographs in its possession, and from them is completing the map of the Reelfoot Quadrangle. No map whatever was available for use as a flying map, consequently the strips had to be flown without a map. After the area was covered by one camera, a sketch map was prepared on a reduced scale, and this sketch map was used as a flight map when covering the area again with the Tri Lens camera. This sketch map proved the length of the lake to be approximately 10 miles, Rand-McNally maps and others show the lake anywhere from 30 to 100 miles long, and of quite different shapes.

The results of this expedition, together with those of the New Hampshire expedition of last year, which was also directed by Captain Stevens, demonstrate that aerial photographic work is best done at about 16,000 ft. with the DeHaviland airplane, as this altitude can be gained in about 50 min., and the air is still dense enough to allow good control of the airplane.

From this elevation a much larger area can be covered in a single exposure than from 10,000 ft., and errors due to changing contour of the country are minimized; also, the air is relatively quiet at this elevation, permitting the camera to be kept quite horizontal, which is a very important feature. In the new T1 camera, Maj. J. W. Bagley has added transparent spirit levels, so placed that they automatically register the position of the bubbles on the film. With the ammonized film it was found possible to produce fully exposed negatives as late as five o'clock in the afternoon, thereby lengthening the possible working day to ten hours.

Farman Activities

W. Wallace Kellett, American Representative for Henry and Maurice Farman, reports the sale of a 1923 Model Sport and Touring Plane to the Ludington Exhibition Co. for touring and demonstration purposes.

C. T. Ludington, president of the company, expects to enter this machine, which will possess several new features, in most of the principal flying meets throughout the Country this coming season. As it would be physically impossible to attend any considerable number of meetings unless the dates of the meetings and the geographical location of the cities holding them, make it possible to fly from one meeting to another, Mr. Ludington is anxious to hear as soon as possible from those who contemplate holding flying meets this year, with events suitable for sport and touring planes, and the approximate dates contemplated for the meetings, so that plans may be made to cover the greatest possible number.

The offices of the Company are at 609 Widener Building, Philadelphia.

French Seaplane Competition

With a view to speeding up the creation of an airway service from Marseilles to Algiers, the French air department is preparing a seaplane competition between these cities. The length of the route is approximately 500 miles, with the Balearic Islands affording a midway stop.

The Marseilles-Algiers airway was originally to have been operated with large rigid airships, but this project was abandoned on account of the great expenditure involved. Another French airline across the Mediterranean Sea is in course of organization from Antibes, near Nice, to Tunis.

Col. Henderson at Monmouth, Ill.

A large group of aeronautical enthusiasts of Monmouth, Ill., recently tendered a dinner to Col. Paul Henderson, Chief of Air Mail Service, during his visit to that city. The banquet marked the opening of a campaign to provide funds for the maintenance of the Monmouth airport.

Col. Henderson outlined in a speech the accomplishments of the Air Mail Service, and its projects for the future. He announced among others that an air mail service is contemplated between Chicago and Kansas City.

Annual Report of the Aeronautical Chamber of Commerce of America, Inc.

The Aeronautical Chamber of Commerce of America, Inc., completes its first year with a remarkable record of performance and enters 1923 with every indication of accelerated growth in the industry.

Membership Doubled in a Year

At the quarterly meeting of the Board of Governors, held in the Executive Offices of the Chamber, 501 Fifth Avenue, January 12th, reports were given indicating 100 per cent increase in membership, among the applications recently approved being:

New Members in Class B

Aluminum Company of America, Pittsburgh, Pa.
American Gas Accumulator Company, Elizabeth, N. J.
Eastman Kodak Company, Rochester, N. Y.
Great Lakes Aerial Photographic Company, Cleveland, O.
C. L. Maguire Petroleum Company, Chicago, Illinois
Splitdorf Electrical Company, Newark, N. J.
The Texas Company, New York City
Wood and Spencer Company, Cleveland, Ohio
Zenith Carburetor Company, Detroit, Michigan

New Members in Class C

W. N. Bennett, College Point, L. I., N. Y.
John R. Gammeter, Akron, Ohio
Valentine Gephart, Kansas City, Mo.
Charles J. Glidden, New York City
Grant Marine Motor Company, Detroit, Michigan
Hugh H. Hirschen, New York City
Orton Hoover, Rio de Janeiro, Brazil
Lawrence Leon, Buenos Aires, Argentina
Henry Wacker, Akron, Ohio

The membership now totals 198.

Mr. Allan Jackson, Vice President of the Standard Oil Company (Indiana) was elected to fill the vacancy in the Board of Governors.

Messrs. I. M. Uppercu (Aeromarine), F. H. Russell (Curtiss), J. R. Cautley (Wright Aeronautical), W. C. Young (Goodyear) and S. S. Bradley, the General Manager, were appointed to serve on the Flying Meet and Show Committee.

Messrs. C. F. Redden (Aeromarine) and Russell (Curtiss) were designated as representatives of the Chamber on the Sectional Committee considering an Air Safety Code under the sponsorship of the Bureau of Standards and the Society of Automotive Engineers.

Following are abstracts from the report for the year 1922 made by the General Manager:

The Aeronautical Chamber of Commerce closes its first year with the conviction that the industry has made distinct progress. Whatever the officers and the staff of the Chamber have accomplished or contributed to this result, has been due largely to the splendid cooperation and sustained interest of our Board of Governors and our members.

The policy of the Chamber has been consistently to urge the necessity to the nation, for commercial and military reasons, of a sound peace-time aircraft industry. This problem has engaged the serious attention of the Secretaries of War and Navy and has been the subject of several conferences with representatives of the Chamber. For some months we were engaged in a nation-wide survey of aeronautical resources, made at the request of the Industrial War Plans Division of the War Department. A detailed report, formulated upon answers received to our questionnaires, was submitted to the Industrial War Plans Division. The Secretary of War made public through the medium of "The Nation's Business" (January 1923) a statement on "How Industry is Being Trained for War," in which were pertinent references to aviation, based, we understand, on the Industrial War Plans Division's interpretation of our survey.

Article by Secretary of War Weeks, The Nation's Business, January, 1923

"But aviation is an even greater problem, for it has many aspects peculiar to itself that make the solution complex and difficult. With aircraft there can be no thought of placing in storage even the proportionate amount of necessary reserves as we have been able to do with guns of all sizes and with tanks and motor trucks and ammunition and a thousand other things the Army would need in war. The cost of aviation reserves in any way adequate would be staggering. And even if we had the planes today, tomorrow might see them useless for war purposes by reason of over-night developments in the science of flying. The logical solution, of course, is to foster commercial development, to create the demand for a peace-time industry. What we have been able to do in that way the War and Navy Departments have done. But it must be a slow business at best, and the means to prepare against our war needs are necessary. Some project for subsidizing commercial aviation development may come."

The Secretary of the Navy was a spectator at the Aviation Events in Detroit in October and, in a public statement, summarized the policy of his Department to the aircraft industry in the following language:

Interview with Secretary of the Navy Denby, Detroit News, Oct. 15th

"It is the desire of the Navy Department to establish its aviation upon the most effective basis, which means aircraft in the air, aircraft attached to surface fighting ships and 'mothered' on airplane carriers (80 to 100 on each vessel), and aircraft on submarines. It also means aircraft attached to the land bases of our defenses on the seas. We have made a start on each plane, but to realize what is necessary for our national security we must build up and encourage the civilian aircraft industry and commercial flying, the rudiments of which we now have, but which must be perfected."

There has been close co-operation between the Chamber and the military and naval air services in matters relating to the development and demonstration of new equipment in national air meets and in other ways, and in the dissemination of educational information, the establishment, classification and listing of air terminals and similar aspects of the art.

Post Office Department—The Chamber shares what appears to be the general conviction that, in its development of the Air Mail Service, the Post Office Department has conferred great benefits upon commercial aviation. In a way, the Air Mail has been a laboratory and its successful operation is a strong means of encouragement to civilian pioneers. The Chamber, therefore, has supported the Air Mail in every way possible, partly by distributing information concerning it, and partly by contact direct with the department officials.

The Post Office Department feels that the Air Mail will eventually be replaced by private operators and in the meantime is endeavoring so to improve the service, by night flying and other developments, that it will be of the greater benefit to the country. In this work it has been the privilege of the Chamber to participate to a degree.

Department of Commerce

Department of Commerce—Our contact with this department has been productive of constructive results. Secretary Hoover, on entering the cabinet, laid down the principle of co-operation with national trade associations as the quickest and surest means of team-work between the Government of the nation and the Business of the nation. Mr. Hoover's helpful attitude toward air law will be discussed elsewhere in this report. In line with his general idea of helping American industry improve its position in foreign as well as domestic

markets, the Secretary, in reorganizing the Department, arranged for new and special service, which has been utilized by the Chamber.

Our contact, outside the Secretary's office, has been chiefly, with the Bureau of Foreign and Domestic Commerce, the Bureau of Standards, and the Bureau of Census. Within the Bureau of Foreign and Domestic Commerce was established an Automotive Division, whose sympathetic co-operation and energy in approximating the immediate needs of aeronautics, have been called to the attention of our members many times. A representative of the Chamber was appointed on a special foreign trade committee, together with representatives of the National Automobile Chamber of Commerce, the Motor and Accessory Manufacturers Association and others. A pamphlet "Selling the World American Automotive Transportation," which contained presentation of American aircraft was prepared and distributed by the thousand throughout the world.

There has been statistical contact with the Bureau of the Census and with the Bureau of Standards there has been increasing intercourse in connection with aircraft standardization. This latter activity is of great importance. The Aeronautical Chamber of Commerce is officially represented on the directing committee, under the sponsorship of the Bureau of Standards and the Society of Automotive Engineers, which is preparing a draft of an air safety code. The idea, as formally stated by the chairman, Henry M. Crane, is *not to devise rigid rules* to be imposed upon the industry, but to suggest and publish a code which will be considered when the Bureau of Aeronautics, eventually to be established in the Department of Commerce, promulgates its regulations. Late in the year, the Chamber was invited by the Department to participate in a radio standardization conference. An interesting feature was a request from the Department of Commerce to the Secretary of the Chamber, to contribute the chapter on "Public Relations" for a survey of trade associations which the government is shortly to publish.

State Department—In this department there has been contact with the consular section, linking up with the commercial attaches of the Department of Commerce.

National Advisory Committee for Aeronautics—In matters of national air policy, and in the consideration of many problems incidental to the art, there has been close co-operation with the National Advisory Committee for Aeronautics. The Committee, through Dr. Joseph S. Ames and its executive officer, Dr. George W. Lewis, co-operated with the Chamber in the First National Air Institute, held in Detroit.

Pan American Union—This organization has been of much assistance to the Chamber in facilitating intercourse in matters aeronautical with the various Latin American countries. Much of the Latin American data in the foreign section of the Aircraft Year Books is obtained through the Pan American Union, and, also, through the courtesy of the Union, copies of the Year Book are distributed to the proper officials in the various Latin American governments.

Legislative

Wadsworth-Winslow Bill—

There has been a continued study of the need of basic legislation designed to encourage, regulate and control civilian aeronautics. The Wadsworth Bill, which passed the Senate last February, contained the essential elements from an aeronautical point of view, but after this Bill was referred to the Committee on Interstate and Foreign Commerce of the House, it appeared to be necessary to add certain important provisions to adequately cover some of the constitutional questions; the situation presented by the International Air Navigation Convention; certain departmental differences, the adaptation of the existing customs, immigration, public health and other regulatory legislation to air travel, some necessary administrative details, as well as certain questions with respect to torts, crimes and court jurisdiction of matters relating to air navigation, as well as questions of form, arrangement and clarity.

While initial efforts toward this legislation date back as far as the armistice, the work began to assume tangible form when the Wadsworth Bill passed the Senate in February 1922. The intelligent and intensive study that has been given to the subject under the direction of Congressman Samuel E. Winslow, Chairman of the House Committee on Interstate and Foreign Commerce, has very greatly improved and strengthened the Bill. Conviction is unanimous that by amending the Bill, incorporating the suggestions that have been evolved by Mr. Winslow, it will meet the need adequately and constructively. It is expected that this will be concluded early in 1923 and that the Bill will be enacted before the adjournment of the present Congress.

Steenerson and Kelly Bills—An account of our activity with regard to the Air Mail legislation has already been given under the discussion of Government Liaison.

Hull Bill—Members of the Chamber were kept fully informed as to the status of the Hull Bill, which would have greatly encouraged Government manufacture, not only of aircraft, but of materials, parts, supplies, etc. The scope of this proposed legislation was so broad and apparently so inimical to public policy that the chief opposition was presented by the War and Navy Departments. The Chamber is advised by the United States Chamber of Commerce that the bill probably will not be recommended by the sub-committee of the Naval Committee before which hearings were held.

Membership

One Hundred Per Cent Growth During First Year—In the first year of its existence, the Chamber has enjoyed a growth of nearly 100 per cent in membership. It now numbers 198, 20 manufacturers of complete units of aircraft or engines, or large operators, in Class A; 50 engineering firms or manufacturers or purveyors of materials, parts, accessories and supplies in Class B and 128 individuals or small operators in Class C. The membership is distributed throughout the United States and 3 foreign countries. Gratifying as this growth may be regarded, the field for extension is fertile and the Chamber, as its facilities and service enable it to do so, is steadily extending its solicitation. The method pursued, which obviously requires considerable clerical work and much personal correspondence, is as follows:—

Index of Prospects by Class. General; those obtained from firms already members.

Circularization of Prospects.

Personal letters, follow-ups and reminders at stated intervals and as opportunities arise which should be taken advantage of.

Verification of Recommendations.

Member Service

Some of the specific tangible services performed by the Chamber for its members are:

General Memoranda—In 1922, eighty (80) memoranda were distributed. These conveyed to the membership notice of developments or record of accomplishment and served as an economical means of communication. In a way, these memoranda form a key to the year's activities of the Chamber.

Information Bulletin—Beginning in June this has been distributed monthly. It serves as a medium for narrating incidents in the activities of members, interpretation of general aviation news, items of peculiar interest to the trade; foreign information, reports by and notes on the performance of the Chamber.

Accessory Information Memoranda—In the membership of the Chamber are many materials, accessory, parts and supply manufacturers and purveyors, whose connection with aeronautics is far more intimate than might seem. To enable the trade to appreciate these manufacturers, and to give them some acknowledgment of the part they are taking in developing the art, bulletins are being issued narrating how each firm became interested in aeronautics, who their officials are, and what is being done for the future. The information in these bulletins has established a more general and sympathetic understanding among the members.

General Sales Bulletins—The Chamber is receiving an increasing number of inquiries for the purchase of aircraft. These come directly from individuals or corporations, from export houses, foreign firms or representatives or are referred to us through the National Aeronautic Association and the Chamber of Commerce of the United States. Sixty-nine (69) of these bulletins have been distributed.

Accessory Sales Bulletins—To assist the materials, accessory, parts and supply manufacturers in obtaining new business, and also to inform aircraft and engine manufacturers, a special series of bulletins is issued weekly embracing data on contracts lets, bids, submitted and bids desired for U. S. Government and other aircraft work, *this data having been made public by the various services.* Twelve (12) bulletins have thus far been distributed.

Purchasing Agent's Guide—To facilitate business among members a card suitable for display or filing has been prepared listing materials, accessory, parts and supply firms. This card, with corrections as new members are added, has been placed in the hands of the purchasing agents of all aircraft and engine manufacturers.

Special Service—When requested, special service is afforded members, involving correspondence, personal contact and research.

Trade Index—An increasing number of inquiries is received for information as to where purchases of specific materials, commodities, etc. may be made and to meet this need a trade index is maintained.

Operating Index—Lacking governmental authority, it is believed the only facilities available for listing aircraft owners and operators are those of the Chamber. This list, including data on equipment and service, is available to members.

Year Book and Other Publications

The Chamber in 1922 took over publication of this annual record, from the Manufacturers Aircraft Association, three editions having been issued. Starting in 1919, more as an industrial catalogue of war effort, the character of the volume has been steadily improved and with such improvement there has developed general recognition of the unique and valuable service the Year Book is performing. It is accepted as the authority on American Aviation and copies are to be found on the desks of government officials and members of Congress and in private and public libraries, of both general and technical nature.

Public Information

Several hundred inquiries were received from municipalities, libraries, public service commissions, private corporations or individuals concerning various phases of aeronautics. Many of these questions required reference simply to historical or current statistical data in our Library; others, such as opinions and reports on the practicability of air transport, coming, for instance from points in the Middle and South West, and from individuals interested in a prospective survey between New York and Chicago. Especial contact has been established with Chicago, Philadelphia, Boston, Hartford, Conn., Davenport, Iowa, New Orleans, La., and Grand Junction, Colo.

Library

The library consists of approximately 10,000 volumes, pamphlets, reports, photographs and maps dealing with the history, development and future of aeronautics. It represents one of the largest aeronautical libraries in the United States.

Labor and Materials

For the convenience of members, an employment list has been started. An investigation is being made of the propriety and advisability of establishing a joint bureau for the common purchase of spruce.

Traffic

Common Representation Before Interstate Commerce Commission—Although the aircraft industry is young and has consequently not begun to feel the embarrassment due to rate and traffic problems, confronting older industries, opportunity was presented for the Chamber to promote common representation before the Consolidated Classification Committee of the Interstate Commerce Commission on April 18, 1922, when hearings were held in New York City covering the tariffs on airplane parts, loose or in packages, in car or less than car lots. After correspondence and conference with members of the Chamber and the Army, Navy and Postal Air Services, it was agreed that the presentation of the joint argument on behalf of the industry should be made by N. F. Sullivan, Traffic Manager of the Curtiss Aeroplane and Motor Corporation. Other representatives of the Chamber, the Army, Navy, and Postal Air Services, were present in person at the hearings which took place in the Committee Room, 143 Liberty Street, New York City. The result of this presentation was an order by the Committee promulgated on June 12, 1922, making it possible for carload shipments of 10,000 minimum pounds of wing panels or wing section, K. D. cowls, elevators, rudders, or stabilizers by carload, loose or in packages, minimum weight 10,000 pounds at the same rate as airplanes. Heretofore it was necessary to ship the above mentioned (should one desire) by carload and pay the less than carload rate on same as no carload rating had been established within the Official Classification Southern and Western territory which includes the United States.

This order in brief meant a saving during the year of many thousands of dollars in freight rates to the shippers of airplane parts.

Uniform Contracts

An important work in connection with revising the contract procedure and obligations of the various Government departments has been begun. On invitation from the Interdepartmental Board of Contracts and Adjustments, of the Bureau of the Budget, Treasury Department and the Procurement Division, Army Air Service, a study of existing and proposed forms of peace-time and war contracts is being made by the industry. Conferences are to be held in Washington early in 1923.

Another interesting work was modification of a new ruling and classification of airplanes and motors for bonding in connection with Government contracts. On protest from the Chamber, coupled with that of the Service the bonding companies concerned made satisfactory adjustments.

Activities at Wilbur Wright Field

According to the Dayton, Ohio, *News* of Dec. 31, the Air Service Depot at Wilbur Wright Field, Fairfield, Ohio, is very active in the rehabilitation of the planes and motors for the Army. The article states:

"During one 30-day period of the summer, 250 carloads of material from abandoned flying fields throughout the country were shipped into Wilbur Wright Field for storage. The large warehouses located at the post and 77 temporary buildings and airplane hangars are used to store this vast material. During the year a total of 879 carloads of supplies were received and 367 shipped at the Fairfield Depot. Being the only repair station east of the Mississippi river, all planes, as well as parts are furnished this territory from Wright Field.

"During the year just closing, 127 airplanes were completely overhauled, reconditioned and sent to other posts and a total of 506 motors were placed in repair at the field and distributed to other air service stations.

"Activities of the supply department of Wilbur Wright Field for the past year have centered around the disposition of surplus, obsolete and unserviceable property, the concentration of all Air Service supplies at this depot and the receipt of material from abandoned stations throughout the United States. Millions of dollars worth of surplus, obsolete and unserviceable property was in storage at this depot in the beginning of the year. The work of the field was in converting as much of this material as was possible into cash and to dispose of the balance of the property. Of the items which have been sold at the Fairfield station, are 2500 aeronautical engines of all types, the original cost of which is estimated at $6,250,000; 700 airplanes of all types and descriptions, original estimated cost placed at $2,800,000. Thousands of instruments, compasses, watches, altimeters, gages and similar equipment were sold or disposed of; 1,500,000 ft. of hardwood lumber, cherry, mahogany and walnut was disposed of through bids. Great quantities of surplus clothing, including gloves, unionalls, leather coats, aprons and like wearing apparel was sold. A unique item for disposition was 5088 magnetos of foreign manufacture originally costing more than a quarter million dollars."

Schneider International Seaplane Race

Provisions of F.A.I. Regulations

The Schneider Maritime Aviation Cup Race will take place in England this year, probably toward the end of August. The selection of the course rests with the Royal Aero Club (the Holders), and their decision will be announced shortly. The Committee of the Royal Aero Club will select the three competitors to represent the British Empire, and reserves to itself the right to hold eliminating trials.

As stated before, entries close on March 1, 1923. The entries are to be made at the Royal Aero Club, 3 Clifford Street, London, W 1, and must be accompanied by the entry fee, £10.

General Conditions for the Schneider Cup, 1923

Art 1.—Clubs entering machines must deposit, in addition to the entry fee laid down in the General Regulations, a sum of 5,000 francs for each machine, as a guarantee of its being present.

The sum will be returned in respect of each machine that is present at the contest.

Navigability and Watertightness Test

Art. 2—This eliminating test will begin with a navigability test and be followed by a watertightness test. These two tests are intended to establish the seaworthiness of the machine.

Art. 3—Each machine must complete a course of from five to ten nautical miles over the sea, or in a creek, gulf, estuary, or bay, as decided by the Contest Officials.

For this test, the competitor must taxi over the starting line, then rise and continue the course, during which he must taxi the machine over two distances of half a nautical mile at a minimum speed of 12 knots, the limits of each of these distances being indicated by two buoys. The remainder of the course will be covered in flight.

The competitor must, however, alight again before completing the course and taxi over the finishing line. The Contest Officials may allow a competitor who has been unsuccessful in this test to make a second and final attempt.

Art. 4—After having taxied over the finishing line, the machine must be moored immediately to a buoy allotted beforehand, where it must remain afloat for six hours without anyone on board. Any machine leaving its mooring during this period will be disqualified.

Art. 5—No repairs will be allowed during the navigability and watertightness tests. Except for changing the propeller, which is allowed, the machine must not undergo any modification between the above tests and the speed contest. It will be stamped to ensure this.

Speed Contest

The Jacques Schneider Cup, in 1923, will be contested over a distance of about 200 nautical miles (the course shall not be increased or diminished by more than 10 per cent). The closed circuit will be at least five nautical miles.

The contest will take place between July 1 and November 15. Competitors may be started all together or at intervals, as shall be decided by the Contest Officials. If competitors are started at intervals, the order of starting shall be drawn by lot and the hour of starting fixed by the Contest Officials. The start may be made either by taxiing over the starting line or by passing over it in flight. The finishing line must be crossed in flight. The course may, if necessary, be taken over the coast, the controls being on land, care being taken to avoid all arrangements likely to impede competitors.

Alightings and repairs are allowed during the contest.

In the event of unfavorable weather, the Contest Officials may postpone the contest as often as they think fit.

New Dornier Pursuit Plane

An interesting pursuit plane has recently been produced by the Dornier plant at Romanshorn, on the Swiss side of Lake Constance. This plane, called the Dornier "Falke" (Falcon), is an all metal cantilever monoplane, and is equipped with a 340 hp. Wright engine.

The construction of the machine follows the principles which are incorporated in other Dornier aircraft, such as the Komet single-engined cabin monoplane, or the Delphin single-engined cabin flying boat. The wing of the Falke is built of steel spars and duralumin ribs onto which duralumin covering is riveted. The wing is of one piece and is connected with the fuselage by means of four vertical streamlined struts. The wing curve is a special aerofoil developed for this purpose by Dornier.

The fuselage is also entirely built of metal, and consists of duralumin longerons, frames and covering. Owing to the raised position of the wing with respect to the fuselage, the pilot enjoys an excellent range of vision from the cockpit.

The tail unit is of a construction similar to that of the wings. The landing gear consists of two wheels which are carried by two streamlined steel tubes inclined outward. It is a notable feature of this machine that it is devoid of any kind of external bracing.

The 340 hp. Wright engine fits nicely into the streamline nose of the fuselage, and is readily accessible, the entire cowling being hinged so that it can instantly be swung out of place. The engine is cooled by a special Lamblin radiator which is mounted underneath the fuselage, between the landing gear struts.

The armament consists of two synchronized machine guns.

The performance figures which are given below have been obtained from tests carried on at the Swiss military airport at Dübendorf in the presence of F.A.I. officials.

SPECIFICATIONS OF THE DORNIER FALKE

Span	10.00 m.	Useful load	560 kg
Length	7.43 m.	Max. speed	265 km.p.h.
Height	2.83 m.	Climb to 1000 m.	1 min 6 sec.
Chord	2.00 m.	Climb to 3000 m.	6 min 3 sec
Wing area	20 sq m.	Ceiling (est.)	8500-9000 m
Engine	340 hp Wright	Endurance	2 hr

The principal stress bearing members of the machine are of chrome nickel steel with an ultimate strength of 75 kg per square millimeter. The safety factor, with normal flying load, is 10.

Aeromarine Notes

Twelve passengers and a crew of two aboard the Aeromarine flying boat "Governor Cordeaux" recently flew from Miami, Fla., to Nassau in the Bahama Islands, a distance of 187 miles in 1 hr 51 min. The steamer time between Miami and Nassau is 18 hr and the ordinary flying time is 2½ hr.

One of the Aeromarine passenger flying boats, the Buckeye, is now equipped with a radio set. The buzzer modulated and radio telephone system is employed in the transmission. The set operates on a wave length of 525 to 600 meters. The telegraph call letters of the Buckeye are KFBY. Amateurs in Florida who are equipped for continuous wave reception now have an opportunity to try their radio sets in listening for the Buckeye's reports during flights between Miami and Nassau or other points.

The railroads of the United States are actively cooperating with the Aeromarine Airways by placing with their ticket agents complete information on the company's flying boat routes. Aeromarine posters and folders are being placed with the railroad ticket offices as well as the Consolidated ticket offices in the principal cities throughout the country.

Making Artificial Rain at McCook Field

Fliers Drop Magnetic Sand and Clouds Vanish

Some highly novel experiments in which the airplane has been used as an adjunct to artificial rain making are reported from McCook Field on the authority of Prof Wilder D Bancroft at Cornell University and L Francis Warren. The two scientists conducted these experiments with the cooperation of the Air Service.

Results of the experiments were described as "absolutely uncanny" by observers at the army flying field. The clouds were made to disappear and precipitate their moisture by the dropping of electrically charged grains of sand upon them from airplanes, according to the experimenters.

Professor Bancroft and Mr. Warren assert that the process will be of great value in the commercial world, as fogs over cities, harbors and flying fields can be made to disappear, thereby insuring safety to travel and transportation. They do not contend that in every instance rain or precipitation can be produced, as all clouds do not contain sufficient moisture. Some of the experiments demonstrated that while slight precipitation was caused, this was evaporated before it reached the earth.

In payment for its cooperation, free use of the process has been given to the Army Air Service, for which patents are pending, for the removal of mists and fogs over the flying fields.

The experiments have been in progress at McCook Field for the last year and a half, and will be continued at Moundsville, W Va., on the Washington-Dayton air route, and possibly at Washington, where fog conditions are more frequent and better than at Dayton.

In announcing the success of the experiments, Mr Warren said that elaborate scientific researches had shown that a particle of atmospheric moisture carrying an electric charge had a tendency to grow in size, even under conditions so adverse to enlargement as to cause uncharged drops to evaporate, the theory being that the electric charge diminishes the surface tension of the drops, and thus facilitates further condensation and coalescence.

In the experiments a Lepère plane, carrying about 80 lb of sand, of about 150 mesh, with a wind-driven generator operating an electric equipment capable of charging the sand with high voltages either positively or negatively at the will of the operator, was employed. The sand was charged to approximately 10,000 volts, or a charge of the order of 0.0006 electric static units per gram, and was scattered through the action of the plane propeller at a height of about 500 ft above the tops of the clouds, the plane traveling at a rate of about 100 m.p.h.

The time taken to precipitate and destroy the clouds, from the period of the first direct attack to the period of final disappearance, in each case rarely exceeded ten minutes, and in several cases was less than five minutes.

The clouds dealt with, Mr Warren said, varied from several thousand feet in length and breadth to several miles, the thickness from 500 ft to 1,500 ft and the altitude from 2,800 to 10,000 ft. The clouds for the most part were of the nature of cumulus and stratus, or haze-like clouds which consist of fog in a horizontal stratum, all containing slight moisture which was quickly evaporated in the dry air below the clouds. Some of the experiments, Mr Warren said, were followed by snow flurries over the flying field and light rainfall over the adjacent regions. Coarse sand that will fall rapidly over a definite locality, thereby producing quick results, will be employed for fogs and mists.

It was found in the experiments that, wherever the charged particles of sand in sufficient quantity were released at the top of a cloud and the cloud was of opposite charge to the sand, a large hole, in a fraction of a minute, was made through the entire cloud from top to bottom.

No large scale attempts were made, Mr Warren said, at artificial rain making with nimbus, cumulo nimbus or other heavy rain clouds, as the experiments were solely directed at the removal of mists and fogs covering areas extensive enough to justify the Army Air Service in installing the process over one of its foggy flying fields. He said that all heavy rain clouds were highly electrified and it was not deemed safe to deal with them with high voltages until measures were taken to guard against possible accidents to the pilots and planes.

At its Moundsville field the Army Air Service proposes to employ a captive balloon, containing an electric equipment and anchored by cable to a truck. The balloon and equipment will keep the field and surrounding regions free from fog, they expect. At night the balloon will be illuminated so that it may be seen by fliers and the location of the open and free landing space determined.

Sampaio Correia II. Ends Cruise

The H10 flying boat Sampaio Correia II which left Key West, Fla. Sept 5, 1922 enroute for Rio de Janeiro, Brazil, arrived at the latter place after an eventful voyage on Feb 8, having taken slightly over five months to cover the distance of 5880 miles. The total flying time was 100 hr 21 min. Lieut. Walter Hinton and his crew were given an enthusiastic welcome by the population of Rio de Janeiro.

As the Sampaio Correia II. landed at 11 32 o'clock the guns in the fortresses were fired, steamers sounded their sirens and the church bells were rung. The waterfront and hilltops were crowded with thousands of persons who had waited since early morning to witness the end of the long flight. The city was in holiday attire, the streets being profusely decorated with Brazilian and American flags.

The aviators were received officially soon after their arrival by representatives of the Aero Club, the North American colony and various civic institutions.

Among those welcoming the aviators before they were taken to their hotel were the Mayor, the famous Brazilian aeronaut, Alberto Santos-Dumont, and Dr Sampaio-Correia, President of the Brazilian Aero Club, for whom the aviators' seaplane was named.

The Hinton expedition, including, besides Lieutenant Hinton, E Pinto Martins, a Brazilian, George T Bye, a New York newspaperman, John Wilshusen, mechanic, and J. Thomas Baltzell, photographer, left the naval station at Rockaway, N. Y., on Aug 17. The party was beset with difficulty almost from the start. The original plane, Sampaio Correia I, was wrecked in landing off Cuba at nightfall on Aug 21, and the aviators were rescued by the United States cruiser Denver. The seaplane in which the journey was finished was purchased from the naval air station at Pensacola.

Lieutenant Hinton was a member of the NC4, the American naval seaplane, which completed the first transatlantic flight made by a heavier-than-air machine. He was also aboard the runaway naval balloon from the Rockaway station which made the sensational flight to Moose Factory, in the Canadian wilderness, in December, 1920.

Helium Building Wrecked

An explosion of unknown origin which occurred in the helium purification plant at Langley Field, Va., Feb 3, killed Ben Johnson, civilian employe of the Air Service, and injured W. E. Snyders, of the Bureau of Mines. The accident happened when the dryer used for compressing air exploded, wrecking the compressor building and the pipe line.

American Air Traffic Rules

The section of the Aeronautical Safety Code which deals with air traffic and pilotage rules is now practically complete. Other sections of the code are nearing completion and it is hoped to have the codes ready for promulgation within the year

Right of Way

According to the traffic rules adopted, airplanes on landing fields, or airdromes, have full right of way over all other traffic Pedestrians and vehicles are not permitted on these fields except in the discharge of some duty connected with airplanes, and even then they are required to keep out of the way An exception is made in the case of some particular area of the field which for purposes of repairs may be marked by red flags or lanterns as not in use

Airplanes landing have right of way over airplanes taking off, both have right of way over airplanes taxiing along the ground, and a machine in distress, on fire, or with a dead engine, has right of way over everything else

Seaplanes maneuvering over the water under their own power are subject to the same traffic rules as power vessels, and in landing or taking off they must give right of way to surface craft.

The rules in the air are similar to those at sea, with the exception that in addition to turning to the right when meeting, the higher of the two machines may rise, and the lower may dive, but they must not pass by rising and diving only A machine over-taking another from behind must pass to the right the same as at sea.

As between different types of craft the less maneuverable has right of way Thus airships have right of way over airplanes, and balloons, captive or free, have right of way over both Formations of several machines traveling together have right of way over single airplanes, but do not have right of way over airships An airship not under control of its own power and displaying two black balls hung in a vertical line, or two red lanterns, shall be considered as a balloon and given right of way as such

Safeguarding the Groundmen

The regulations also provide for the safety of persons on the ground Nothing may be dropped while in flight except ballast, and this ballast must consist of water or fine sand arranged to be dropped loose An exception is made in the case of certain restricted areas where cargo attached to a parachute may be dropped. Stunt or trick flying is prohibited over built up areas, near airdromes, or anywhere else where it is likely to endanger others than the participants

The altitudes at which built-up areas may be crossed are specified, these being governed by the width of the area and being so chosen that in cases of engine trouble a machine will be able to land in an open area, such as a park or river, where its fall will not endanger persons or property on the ground Landing in public highways or other areas not expressly reserved for the purpose is prohibited except in emergency, and then the landing plane must give right of way to everything else.

Other Provisions

Other provisions of the code deal with maneuvering of airplanes in the vicinity of airdromes, and the starting of their engines. The latter part is still unsettled. The signals in use in the United States differ in some slight respects from those in use in other countries, and it is hoped to get them more nearly alike in order to prevent danger of misunderstanding when an American plane lands in Canada or a Canadian plane lands on this side of the line

Rules providing for the use of airways are included These are lines over which air traffic regularly passes and will be equipped with regular and emergency landing fields at suitable intervals A pilot leaving an airdrome for a cross country flight is required to notify the commander of the airdrome of his intended destination This makes it possible to send out and look for him in case he does not arrive. He is also required to inform himself of the weather conditions at the other end of his journey

Passenger Overtakes Train in Plane

The kind of service a well equipped airplane company should be prepared to give at short notice is reported by the Johnson Airplane & Supply Co, of Dayton, Ohio

Last November C J Haskell, President of the Furman Oil Co, was a passenger on the crack "St. Louisan" enroute from New York to St. Louis. At Dayton he stepped off the train to secure some medicine for his wife. The porter informed Mr Haskell that he had ten minutes to spare but the train pulled out in about six minutes and left him stranded

About half an hour later Mr Haskell got in touch with the Johnson Airplane & Supply Co Fortunately the company always has planes ready for emergency work, so that it was a matter of only about forty-five minutes after the train left before a Johnson plane was speeding Mr Haskell toward Indianapolis. Telephone arrangements had been made for a taxi to meet the plane at the Indianapolis landing field, and although the taxi was ten minutes late, Mr Haskell overtook his train

Mr Haskell acknowledged the splendid service he had received in the following telegram:

"Johnson Airplane Co

Passenger Service, Dayton, Ohio

"Damned fine pilot good plane and two minutes to spare at Indianapolis Thanks for your kind of service"

The plane used was a Vought VE7 powered with 150 hp Hispano, with a high speed of 110 m p h

The Johnson Co announce that their new spring supply and equipment catalogue is now ready for distribution

Radio on American Civil Aircraft

Six flying boats and one land airplane have recently been licensed by the Department of Commerce to carry radio on board They are the first American civil aircraft so equipped Army and Navy aircraft have for some time past been fitted with radio apparatus, but government machines need not be licensed, whereas civil aircraft do.

The first American civil aircraft to be licensed as a "limited commercial station" was one belonging to the Airline Transportation Co of California. The Aeromarine Airways, Inc., followed with the "Buckeye" in December, and licensed five more recently Radio equipment, officials believe, will make for greater safety in over-sea travel and insure prompt aid should the craft be forced down

AIRCRAFT LICENSED AS LIMITED COMMERCIAL STATIONS ON 525 METERS

KFBI Airline Arrow No 1 Airline Transportation Co. Los Angeles, Calif —Aug 1922

KFPA Balboa, Aeromarine Airways Inc., New York City Jan 18 1923

KFBY Buckeye, Aeromarine Airways, Inc New York City —Dec. 22 1922.

KFRP Gov Cordeaux Aeromarine Airways Inc., New York City.—Jan. 18 1923

KFBJ Nina Aeromarine Airways Inc , New York City —Jan 18, 1923

KFBM Ponce de Leon Aeromarine Airways Inc., New York City.—Jan 18 1923

KFBZ Santa Maria, Aeromarine Airways Inc., New York City —Jan 18 1923

Spanish Helicopter Rises 80 ft.

According to press dispatches from Madrid, a helicopter built by a Spanish engineer, Juan la Cierva, successfully rose to a height of 25 meters (81 ft) and carried out several horizontal flights. On one occasion the machine flew beyond the limits of the Getafe airdrome where the trials took place

The helicopter was piloted by Lieutenant Spencer, a Spanish army flier It is supported by a four-bladed screw and carries an 80 hp engine No further details are on hand.

With this performance the present unofficial world's records for free helicopters stand as follows.

Duration—Oehmichen helicopter, 2 min 37 sec., France

Distance—Oehmichen helicopter, 250 ft , France.

Altitude—La Cierva helicopter, 81 ft Spain.

ARMY AND NAVY AIR NEWS

Air Service

Army Orders—First Lieut Robert T Zane, A S , from A I D Middletown, Pa , to Panama Canal Zone.

First Lieut. Joseph K Baker, A.S., relieved from training at Balloon and Airship School, to Scott Field for duty

Resignation of Capt John Hamilton Chew Williams, A S., and of First Lieut Welcome Bridges Elston, A.S , accepted by the President

Previous order to First Lieut Richard H Magee, A S , is revoked.

Maj Ford Ashman Carpenter, staff specialist, O R C, Scott Field, ordered to active duty with his consent for one week

Capt. Lloyd N Kessling, and First Lieuts. Cyrus Betts and Neil Creighton, A S , from Philippine Dept. to report to Adj Gen.

Capt Idwal H Edwards and First Lieut Raphael Baez, jr , A S , from Philippine Dept to Kelly Field

First Lieut Willis R. Taylor, A S , from Philippine Dept to Crissy Field

Capt Vernon L Burge, A S , and First Lieut Norman D Brophy, A.S , from Kelly Field to Philippine Dept.

First Lieut. Robert E Selff, A S, from Crissy Field to Philippine Dept

• • •

Langley Field Tactical Students Have Rough Air Voyage—A flight of six Martin Bombers recently carried nineteen members of the Air Service Tactical School from Langley Field, Va., to Aberdeen Proving Grounds, Md The day (Thursday) was beautifully clear and smooth, flying over the waters of the Chesapeake, but bitterly cold, and, "sitting out on the front porch" of a Martin, one failed to appreciate the passing scenery After landing in two three-ship formations at Aberdeen, the entire party was hustled into waiting busses, and carried out to the experimental bomb testing range. After witnessing several interesting demonstrations, the party proceeded to the Camera Obscura range, lunch being served enroute After watching a Martin and a DH drop several bombs of different types, the party returned to the bomb storage warehouses, and thence to the museum

Next morning the party left for Edgewood and spent a very interesting and instructive day, gaining an insight upon the problems of gas warfare Returning to Aberdeen in the afternoon, the flight took off for Bolling Field Returning home Sunday was one of the roughest trips in the experience of the most aged veterans. Low hanging clouds, a high wind and squalls of rain leagued forces in an effort to make everyone miserable

• • •

National Guard Officers at Brooks Field for Training—The following named National Guard officers reported to Brooks Field, San Antonio, Tex , for primary flying training

Capt Benjamin R Jacobs and 1st Lieut. Raphael R Dieden from Indiana, 1st Lieuts Joe F Westover, Ralph F Jerome and 2nd Lieut John J Hinkens from Minnesota, 2nd Lieuts. William N Finley, Obe W Carman and Edwin C Brockenbough from Maryland, and 2nd Lieut. Joseph K Barber from Massachusetts.

Many of these officers were in the Air Service during the World War, and in their cases their flying instruction will be in the nature of refresher training The remainder of these officers will take the regular flying course in the morning and ground school instruction in the afternoon.

Made Unconscious by Cold at Great Height—Lt James D Summers, a pilot of the 1st Pursuit Group at Selfridge Field, Mich , fell from an altitude of 19,000 ft to within 400 ft of the ground on Jan 27, a drop of nearly four miles, before he recovered his senses, righted his plane and made a safe landing

Lieut Summers had been ordered to take part in maneuvers by Brig Gen William Mitchell With several other aviators he mounted to a height of 19,000 ft., when thermometers on the planes registered 20 deg below zero

Summers was only half conscious when other aviators reached him after his descent. Examining physicians announced that vital nerves over both eyes had been frozen, causing temporary blindness, and that unconsciousness probably followed in a few seconds.

Describing his experience, Lieutenant Summers is reported to have said

"At 19,000 ft. my motor was running smoothly, but the cold seemed to chill me I was making about 175 m.p h Suddenly everything began to get hazy and I started to work the controls Then everything went black. When I revived I was dropping rapidly and but 400 ft. above the earth Somehow, I don't know how, I got my ship under control and made a safe landing"

Other aviators in the group with which Lieutenant Summers was flying also were unable to account for the sudden righting of the plane, having considered it impossible to make a safe landing from such a low altitude

• • •

Construction Work at Bolling Field—Various construction projects amounting to $32,317 85 have been approved by the Secretary of War for certain army stations throughout the United States. Plans and specifications have been drawn by the Construction Service of the Quartermaster Corps and bids will be invited from local contractors The projects include the construction of a testing range at Bolling Field

Coming Aeronautical Events

AMERICAN

May —National Balloon Race

FOREIGN

1923

March 1 —Entries close for Schneider Cup Race

March 15 —Entries close for Dutch Height Indicator Competition.

March 23 —Entries close for Gordon Bennett Balloon Race.

June 25-30 —International Aero Congress, London

July 20-Aug 12 —International Aero Exhibition, Gothenburg, Sweden

Aug. 6-21 —Sailplane Meet, Vauville, near Cherbourg, France.

Sept. 23 —Gordon Bennett Balloon Race, Brussels, Belgium.

Dec. 1 —Entries close for French Engine competition.

Graduation Exercises for Advanced Flying Students—Graduation exercises for the class of 65 students attending the Air Service Advanced Flying School at Kelly Field, were held on Dec 21 Lieut Col. Culver, Corps Area Air Officer Lieut Col. Howard, Commandant, and Maj. Lewis H. Brereton, Assistant Commandant, addressed the class Colonel Culver presented the members of the graduating class with graduation certificates

The Bombardment graduates comprised Maj. Charles J Browne, Capts William E Lind and Joseph H Davidson, 1st Lieuts. Ross F. Cole and Harry J Martin, 2nd Lieuts Charles L. Williams and Robert W C Wimsatt. Lieut TcHsueh Shen (Chinese Navy), Lieut Von Poulson (Coast Guard), Lieut Edwardo Labordo (Cuban Army), and Cadets Herbert M. Newstrom, Winston A Blizzard, G L Davasher, Richard W Phillips, Oscar P. Hebert and Edward A Rees.

The Observation graduates were as follows Maj Hugh J Knerr, Capt. Donald Wilson, 1st Lieuts. Raymond S Jett, Charles McK. Robinson, James B Carroll, Raymond C Zettle, 2nd Lieuts Lawrence J Carr, Frank T Honsinger, Arnold H Rich. Leroy Ponton de Arce, David W Goodrich, Donald B Phillips, Cadets Anton Hruza, Russ N Nugnet, Leland L. Jones, John F. McGowan, Edwin Matuelia, J. F Milatzo, G W O'Connor, John F Riddle, F. M. Seward Robert C Ashley, John B Boussard, Charles R Bowman, Arthur L. Caperton, Edward H Conerton, Robert H Fatt, L D Fredericks, Herbert Gamble, John B. Giles, L C Goldsmith, Wayne S. Green, Paul R Greenhalgh Paul E Holdbrook, Stanley C Huffman, George C McGinley, Oliver R McNeal, Hugh L. Mays, H C Munson, Russell Pyles, Henry T Scott and J. J. Welker

The Pursuit graduates were 1st Lieuts. Alvin C Kincaid, Anby C Strickland, Cadets Raymond H Harris, L N Thomas, D G Warner and Lee Q Wasser

Lieutenant Shen (Chinese Navy) left Kelly Field for San Francisco, to return to China Lieutenant Lohorde (Cuban Army) departed for Rantoul, Ill. and Lieutenant Von Paulson (Coast Guard) for station at Boston, Mass

* * *

Louisville, Ky., Airdrome—The War Department announces that the Reserve Airdrome at Louisville, Ky., has been named "Louisville Airdrome, Bowman Field" in honor of A H Bowman, a patriotic citizen of Louisville, Ky.

Naval Aviation

Scouting Squadron Reaches Honduras—The following is the summary of latest reports from the Scouting Squadrons, U S Atlantic Fleet, enroute from Key West to Panama

Fourteen of the eighteen planes have arrived at Trujillo, Honduras. Tenders Wright, Maury, Mallard, and Sandpiper are also at Trujillo.

Two planes are at Hog Island, Honduras Two more planes are at Riverdale, British Honduras These four latter planes have experienced slight motor trouble and joined the major portion of the squadron at Trujillo Feb 6

* * *

Naval Orders—Lieut j g Marion E Crist, det Nav. Air Sta Pensacola, Fla., to Airc. Sqds. Battle Fleet.

Lieut j g Samuel L. LaHache, det Nav. Air Sta. Pensacola, Fla.; to Airc Sqds. Scouting Fleet

Lieut j g Frederick W McMahon, det Nav Air Sta. Pensacola, Fla , to Airc. Sqds Battle Fleet

Lieut. j g Adrian O Rule, det. Nav Air Sta Pensacola, Fla ; to Airc Sqds Battle Fleet

Ens. Cato D Glover, det Nav Air Sta. Pensacola, Fla.; to Airc. Sqds. Scouting Fleet.

Comdr Joseph A. Murphy (Med. C.), det Nav Air Sta San Diego, Calif ; to continue treatment at Nav Hosp San Diego, Calif

Ens. Charles G Shone det. Nav Air Sta. San Diego, Calif.; to U S S. Idaho.

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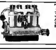

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